INTEGRATED SIMULATION OF THE FRONT-END OF A NEUTRINO FACTORY

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Other Contributors: Robert Palmer, Nikolai Mokhov

Objectives

The primary goal was to design and model the front end as a complete lattice from just after the target to just before the linac with the following design goals.

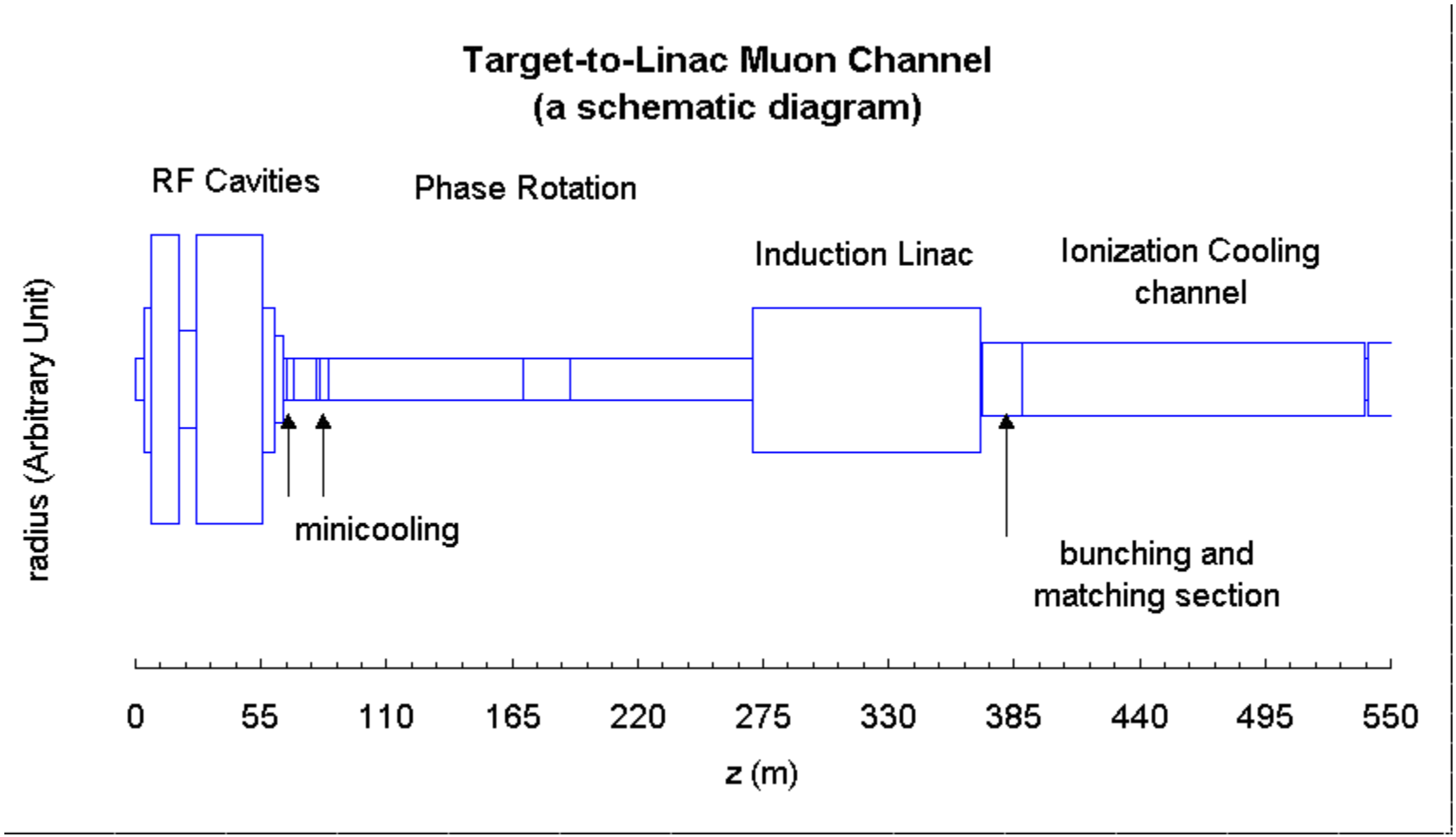
Design Goals

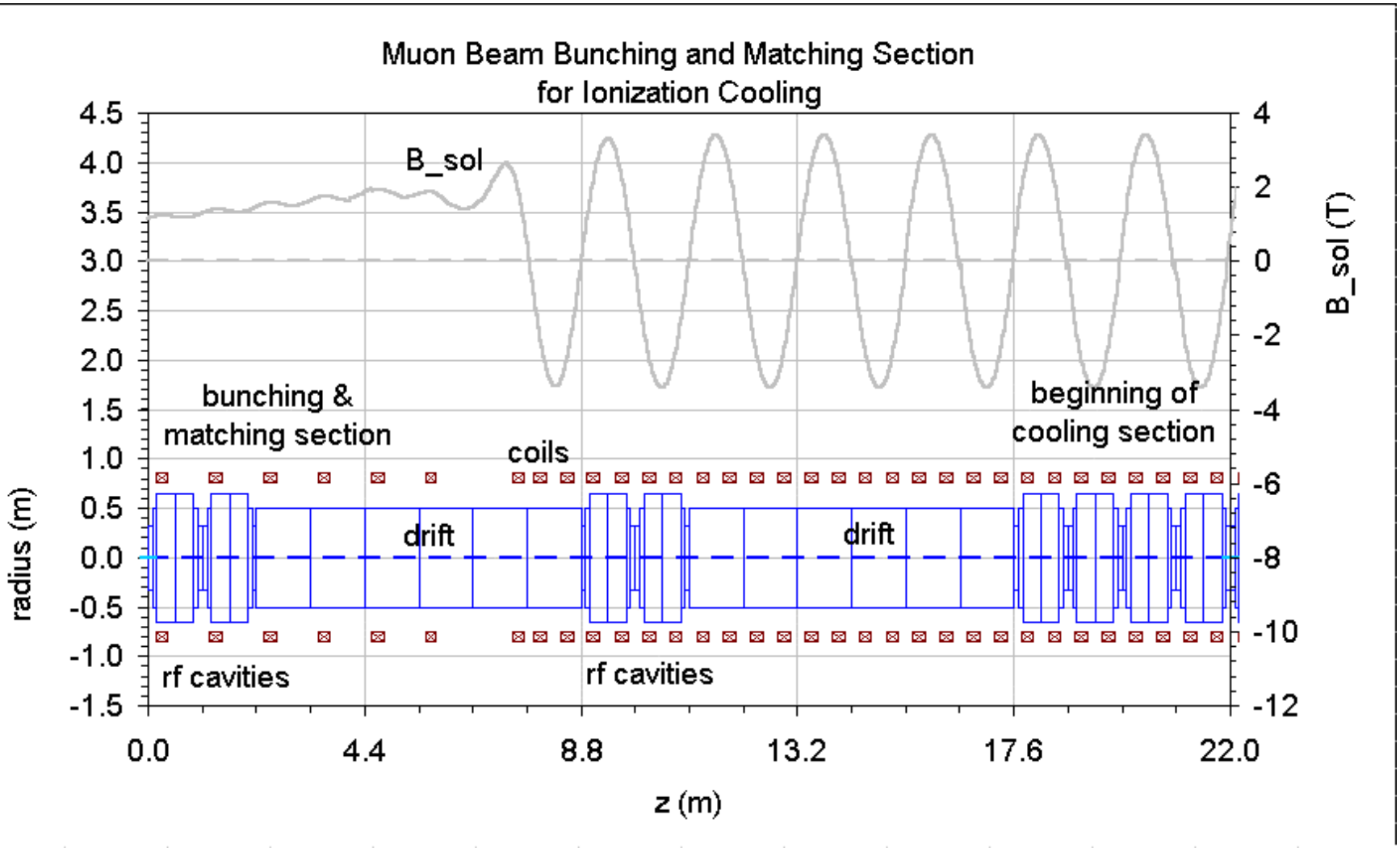
(PJK parameters, MUC046, R. B. Palmer)

Transverse emittance ε_x = 0.0015 m-rad normalised

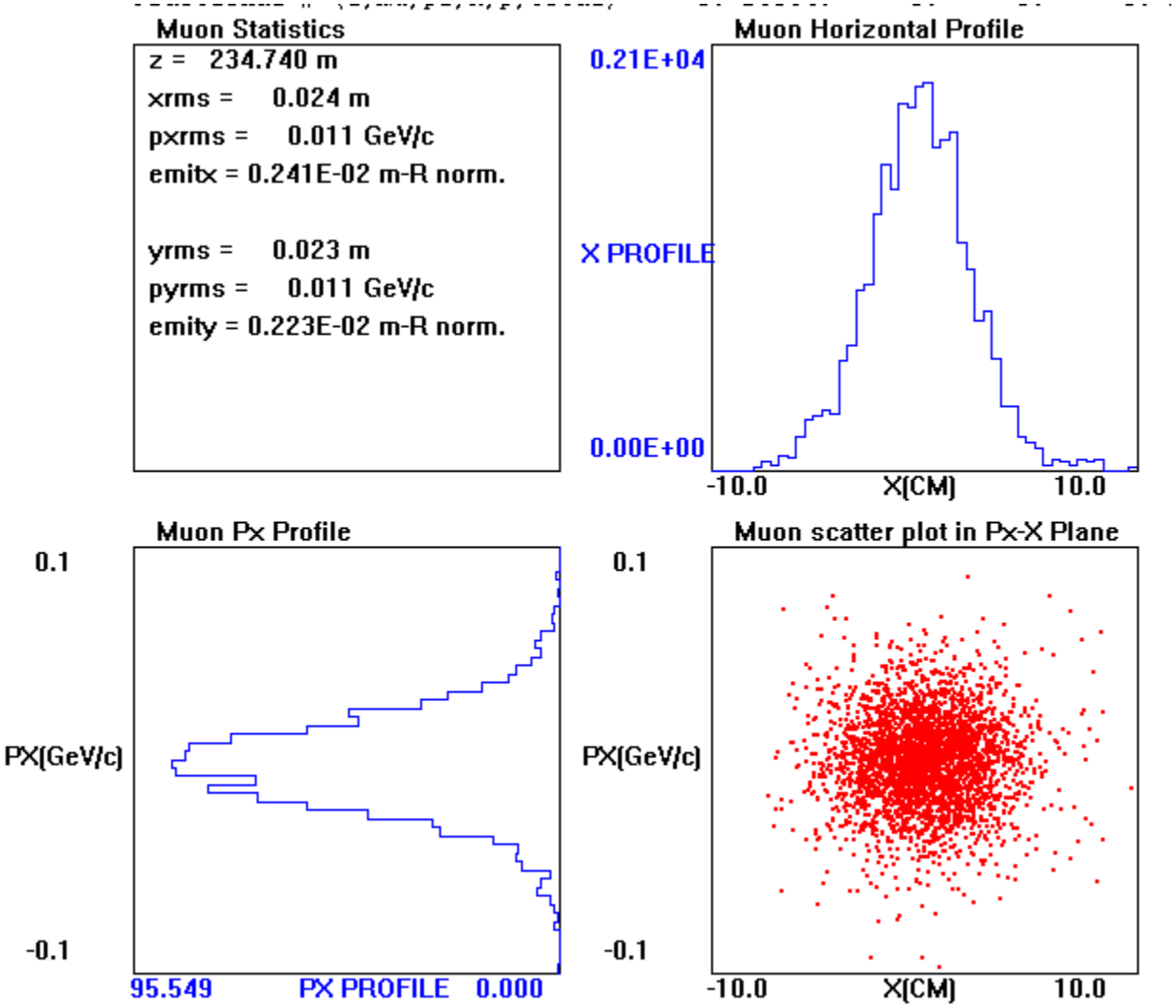
Longitudinal emittance ε_z = 0.028 m-rad normalized

Number of μ+ transmitted / number of p+ in the driver > 0.1


Target-to-Linac Muon Channel
(a schematic diagram)
RF Cavities
Phase Rotation
Induction Linac
Ionization Cooling
channel
radius (Arbitrary Unit)
minicooling
bunching and
matching section
0
55
110
165
220
275
330
385
440
495
550
z (m)

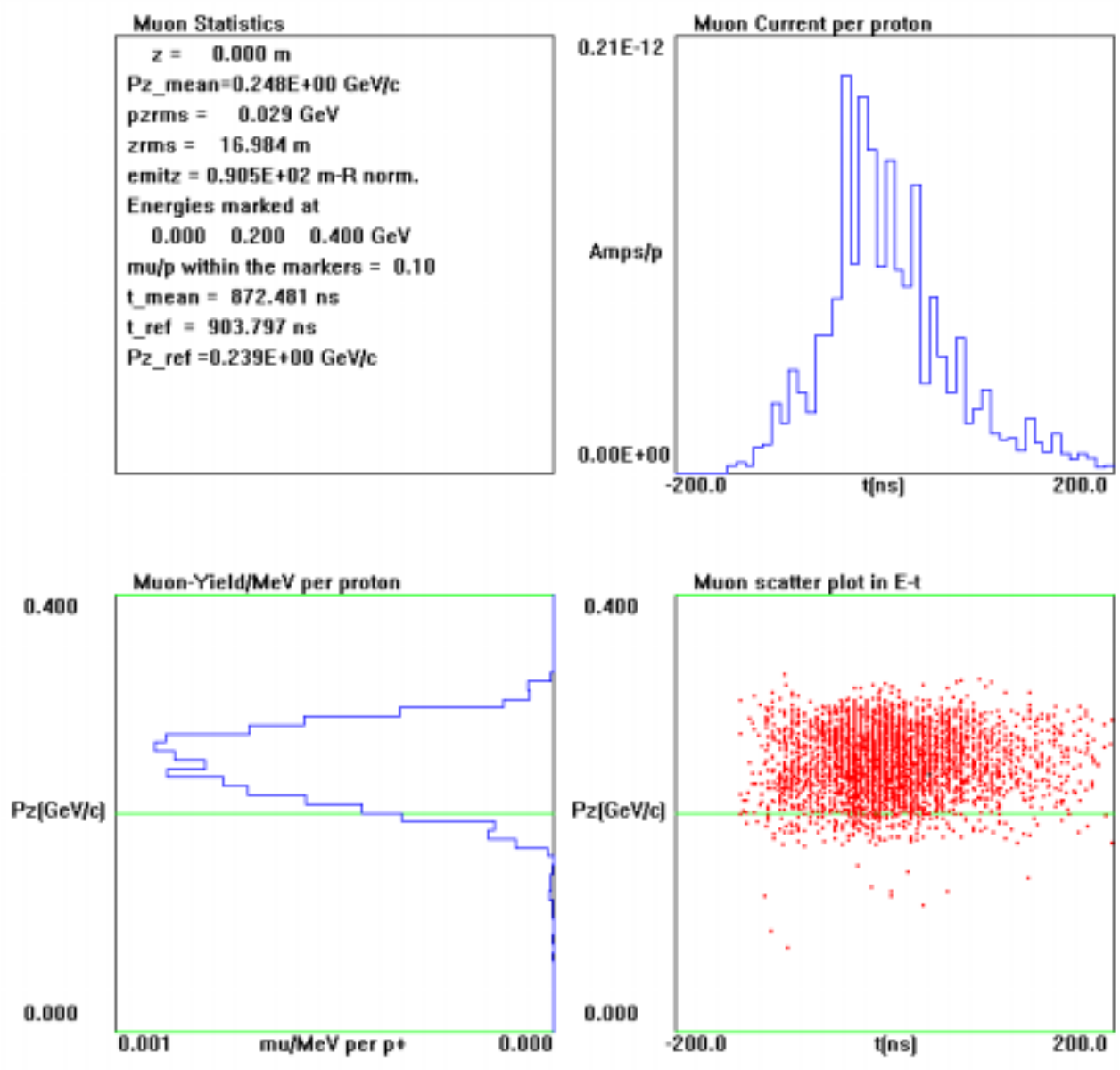

Muon Beam Bunching and Matching Section
for Ionization Cooling
B_sol
bunching &
matching section
coils
drift
drift
beginning of
cooling section
rf cavities
rf cavities
radius (m)
B_sol (T)
z (m)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
4
2
0
-2
-4
-6
-8
-10
-12
0.0
4.4
8.8
13.2
17.6
22.0

Transverse distribution at the end of the cooling channel

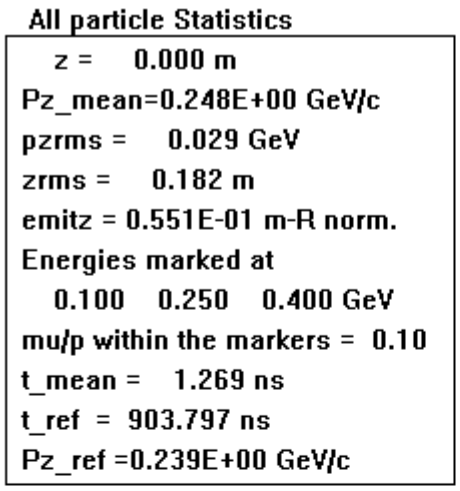


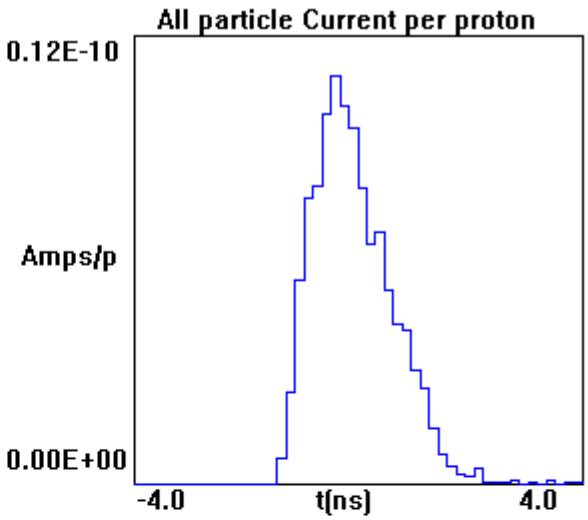
Longitudinal Distribution at the end of the cooling section

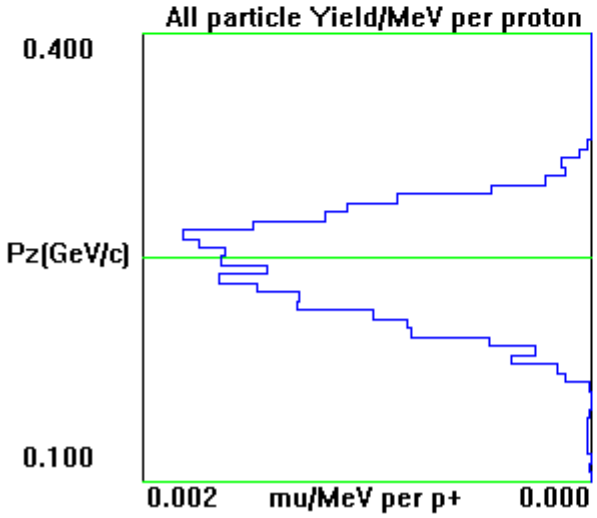
Longitudinal distribution at the end of the cooling channel.

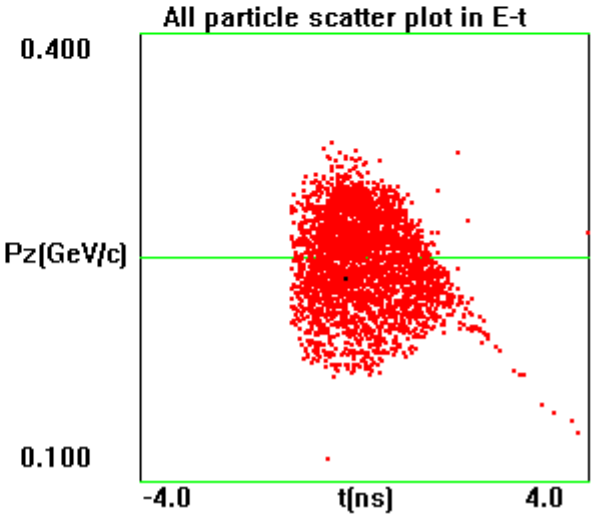


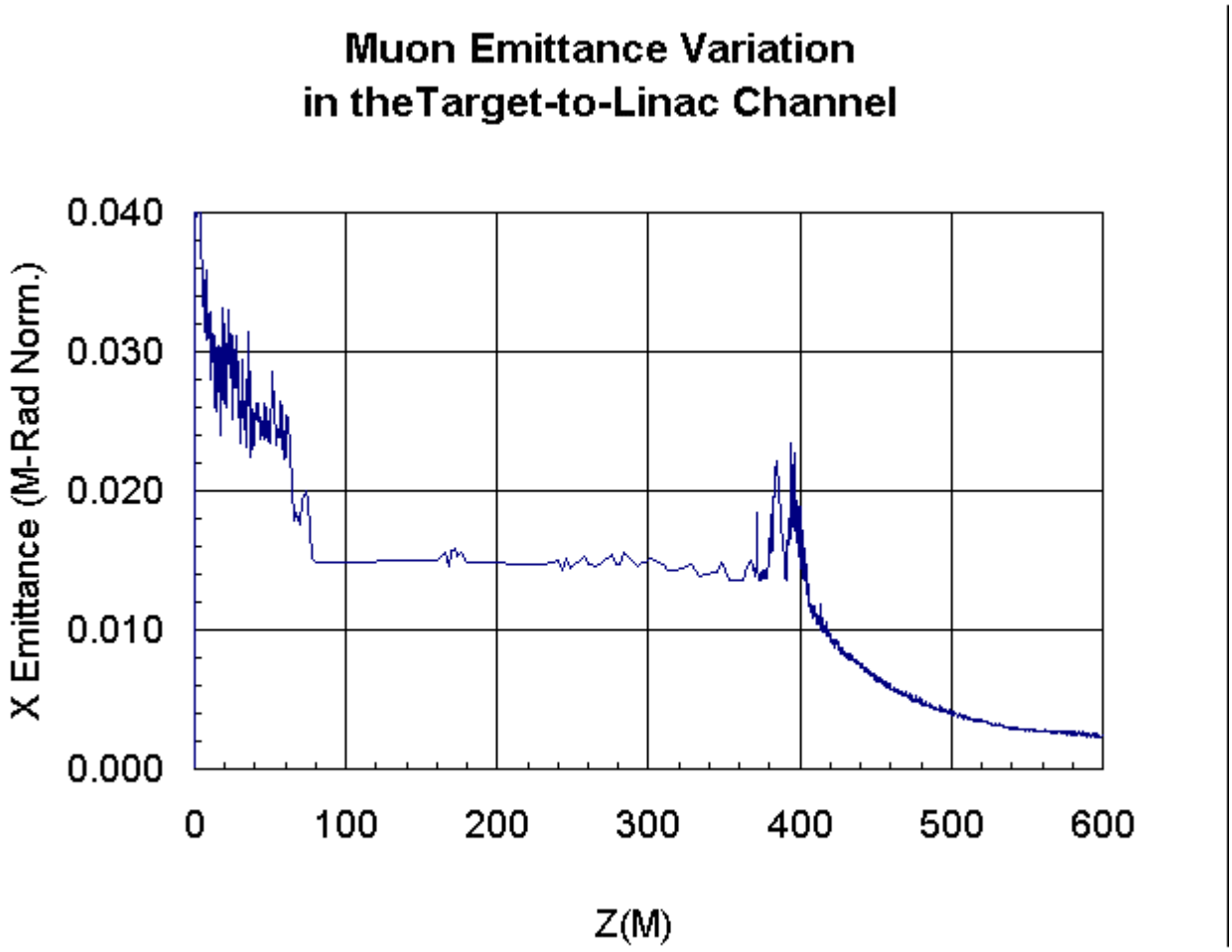
Longitudinal Distribution at the end of the cooling section
All bunches layed on top of each other

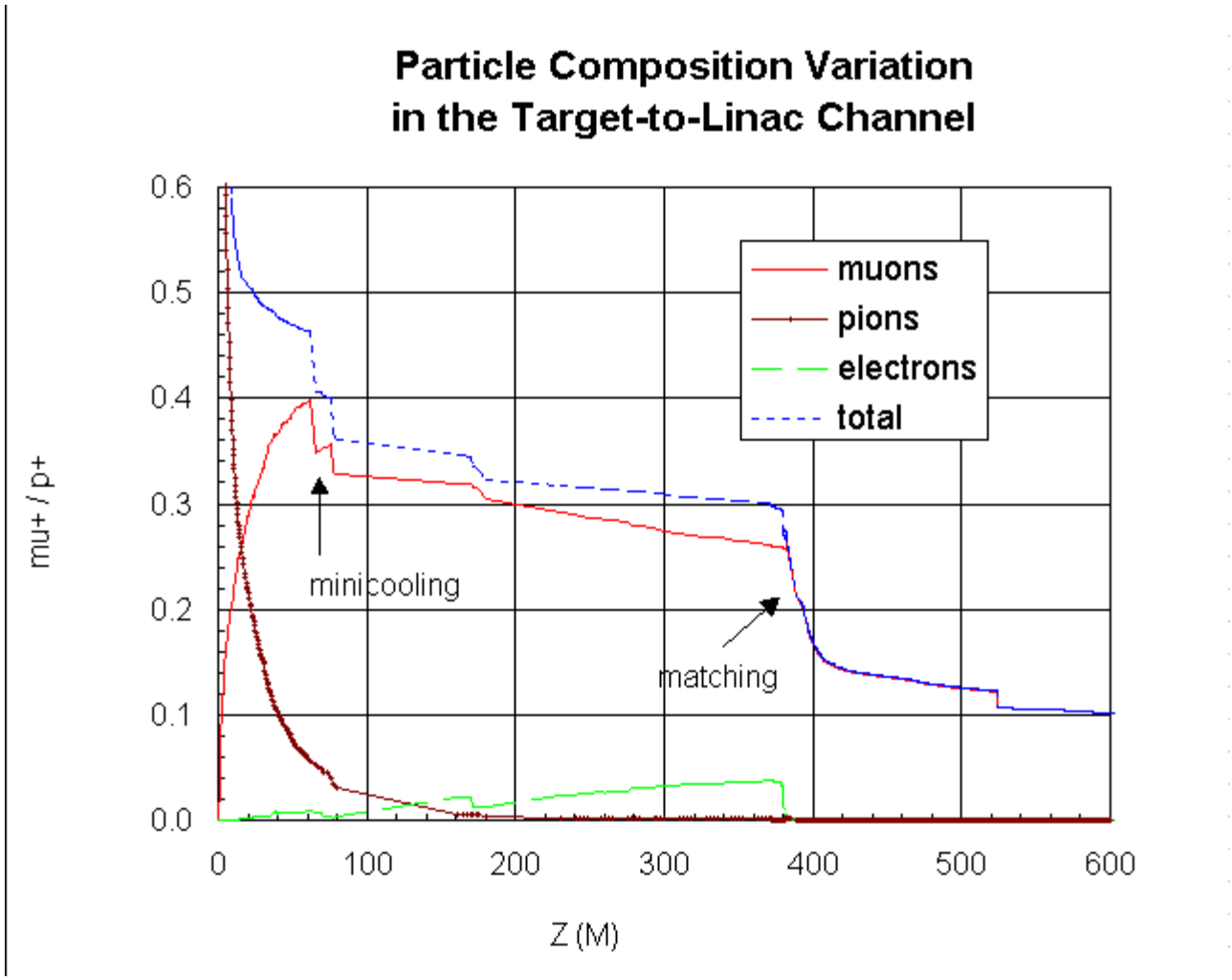


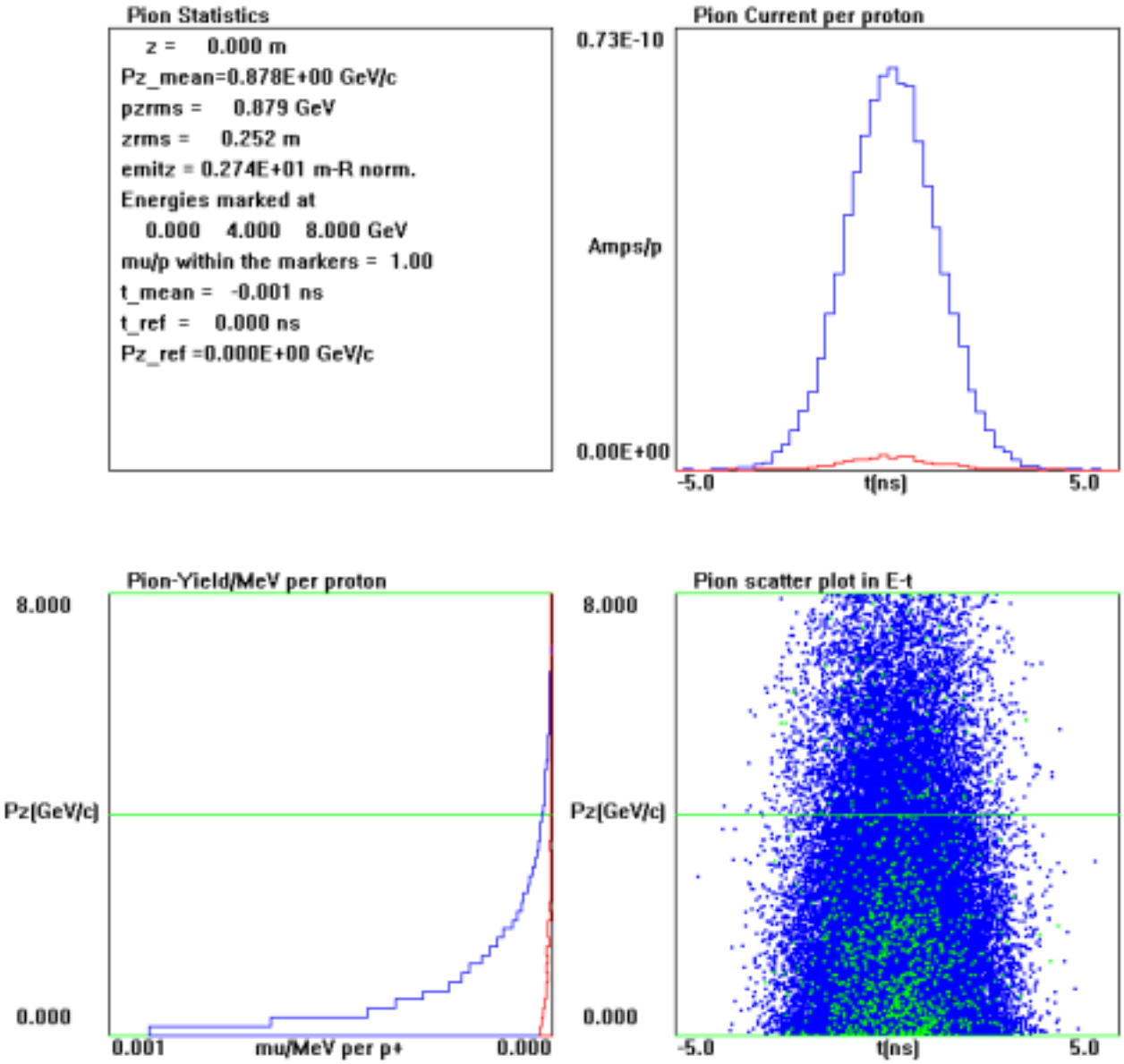






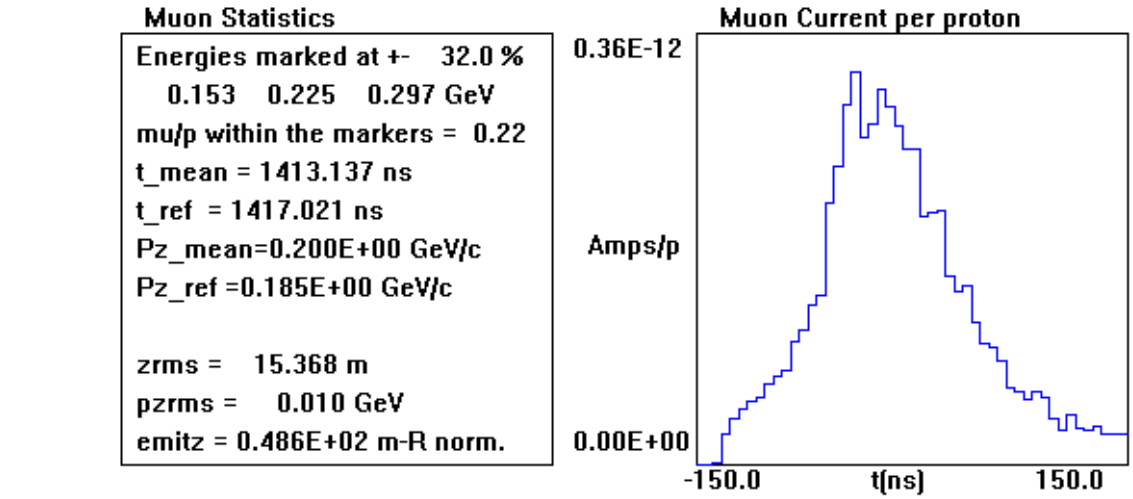

Muon Emittance Variation
in theTarget-to-Linac Channel
X Emittance (M-Rad Norm.)
0.040
0.030
0.020
0.010
0.000
0
100
200
300
400
500
600
Z(M)

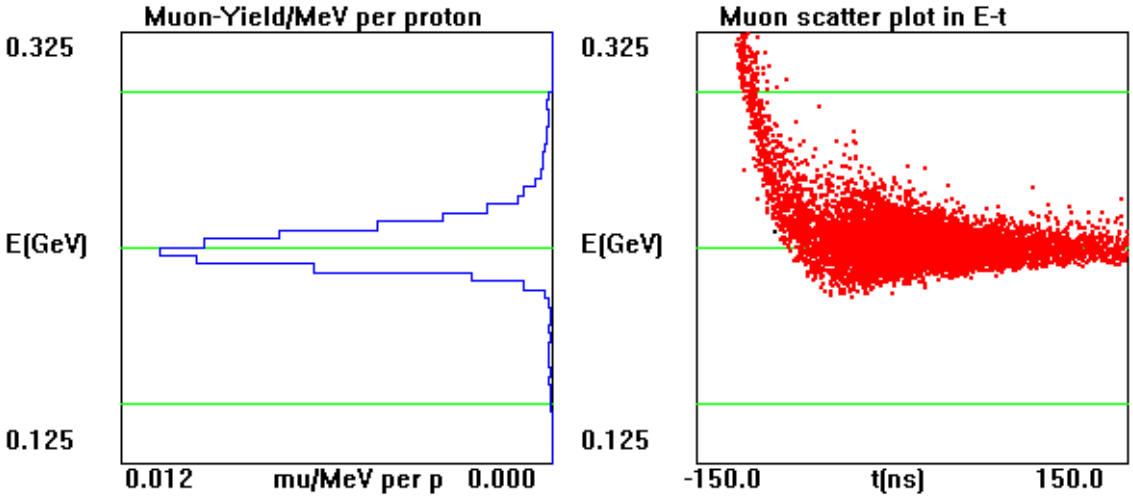

Particle Composition Variation
in the Target-to-Linac Channel
mu+ / p+
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
600
Z (M)
muons
pions
electrons
total
minicooling
matching



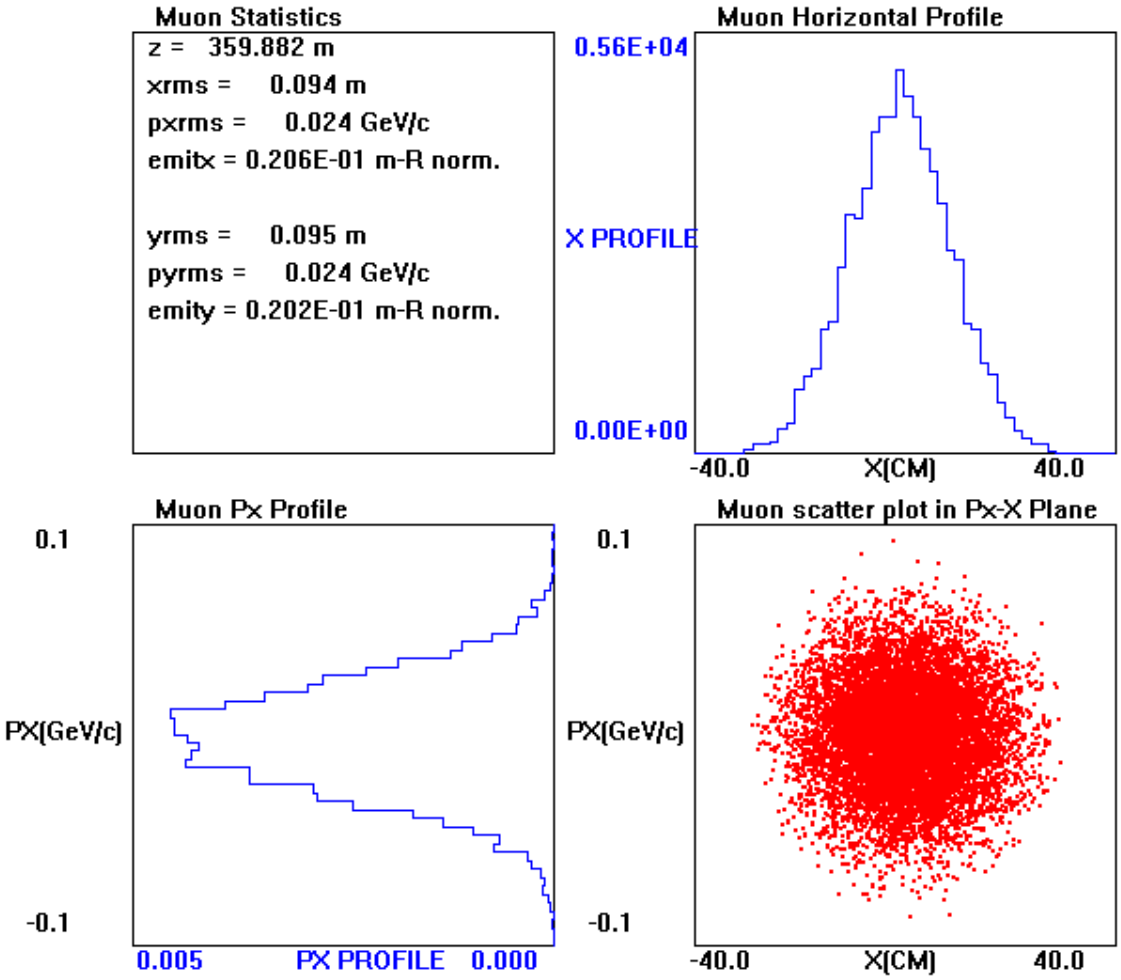
Vital Longitudinal statistics are displayed in the upper left box.

Longitudinal distribution just before the matching/bunching section.





Transverse distribution just before the matching/bunching section.



Lost particle distribution: Transverse distribution at the beginning of the cooling channel minus muons survived in the cooling channel.
This plot shows that the large input beam emittance to the cooling channel is responsible for the loss.